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SOIL PINEAPPLE PROBLEMS.

3rd ARTICLE. - SOIL AERATION AND WEIGHT.

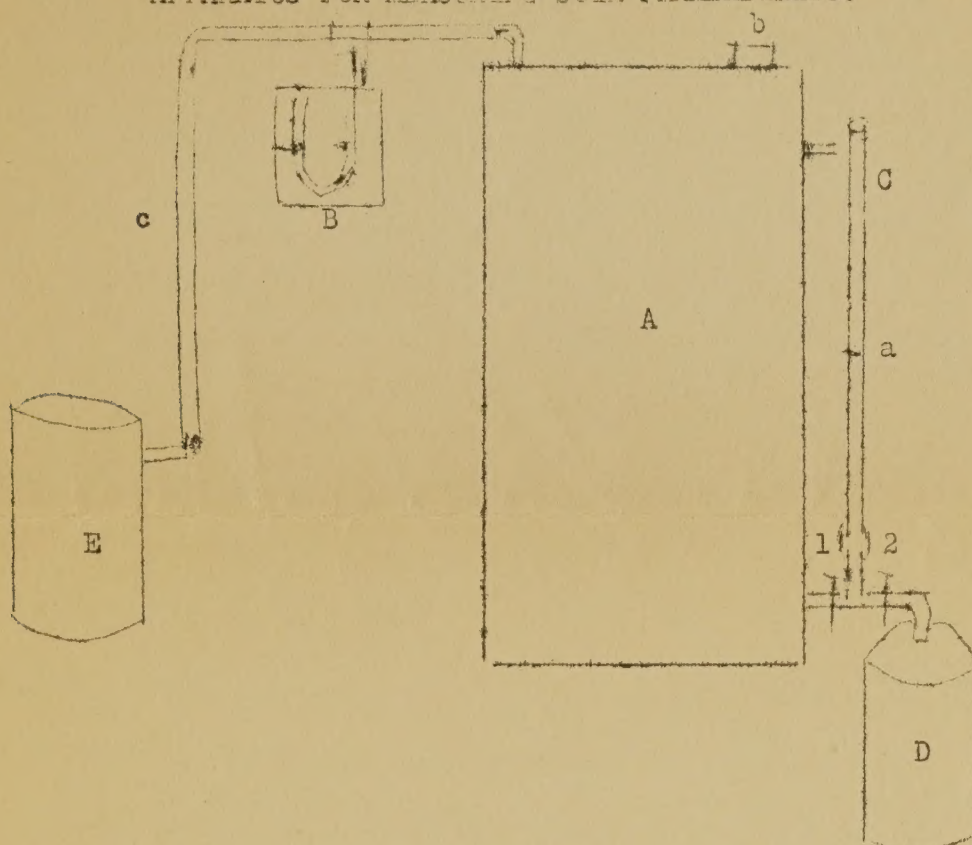
By Henry C. Henricksen.

MAXIMUM AIR. - Generally the root system of the pineapple plant consists of some fine well branched roots that go down deep in the soil, and others that are much coarser and less branched which remain closer to the surface. In soils consisting of a shallow surface, underlaid with rock or other more or less impervious material, the entire root system consists of coarse surface roots. That part of the root system is undoubtedly the one belonging especially to the plant in its primitive state where it grows in rock crevices and hollows filled with leaf mold. The cultivated plant, although it thrives in various soils, has not overcome some of its ancestral habits. It thrives especially well in a loose soil of shallow depth, provided the moisture is sufficient. It grows very poorly in pots, in what is considered a good garden soil. For pot culture coarse sand is better than soil, and gravel is best of all. Also, it grows ^{very} well with the roots hanging suspended in the air, provided the air is kept moist, the light excluded, and nutrients supplied in the leaf bases. It is evident, therefore, that maximum air is not in itself a problem. Experience shows that the better aerated a soil is the better it is fitted for pineapple growing, provided it will retain enough water to supply the plants requirements.

MINIMUM AIR. - It was stated in the former article that the problem of maximum water is principally one of minimum air, or in other words one of the causes of a deficiency in aeration is that of poor drainage, but a soil may be well drained and yet it may not be well enough aerated to be suitable for pineapple growing. If the individual soil particles are all extremely small they pack together so closely that air movement is impeded. If the soil contains considerable clay and not much humus the surface is liable to crusting after heavy rains and that hinders air circulation. If the clay in the soil becomes puddled, which it does at times and in places by cultivation, the soil is, temporarily at least, rendered unfit for pineapple growing. Much irreparable damage is caused to a pineapple crop by even stepping on the soil after the beds are made. In fact, anything that serves to firm the soil should be scrupulously avoided.

The best proof of this is, of course, the behavior of the plant. It can be shown that many seemingly obscure plant conditions are due, wholly, or partly to impermeable soils. Unfortunately, a method for measuring permeability, which is simple enough for a planter to use, is not infallibly accurate, but the one used in these investigations is of considerable practical value and merits a trial by those who desire to learn more about their soils.

APPARATUS FOR MEASURING SOIL PERMEABILITY.



A - Air-tight tank, about 30 liters capacity, with inlet and outlet tubes as shown and opening with screw cap for filling.

B - Manometer, consisting of a piece of board with a narrow U shaped glass tube attached. The tube is half filled with water, and a strip of millimeter ruled paper is pasted onto the board at the top of the water columns.

C - Glass tube open at upper end. D - Container, about 1 liter capacity.

E - Soil tube 3-9/16 inches diameter and about 8 inches long. It is closed at the upper end near which an air tube is soldered.

Arrange the apparatus as shown in the drawing. Fill tank with water through opening b and tighten screw cap air-tight. Detach soil tube E, press it into the soil in a pineapple bed to a depth of five inches. Carry it carefully to the apparatus and attach it by means of the rubber tube c. Open stopcocks 1 and 2 to start the water running into the container D. Manipulate the cocks in such manner that the flow of water makes a 2 mm vacuum on the manometer while the column in tube C remains at the mark a. After the adjustment is properly made empty the container D, note the time, in minutes and seconds, and simultaneously replace the container. Let the water run five to ten minutes and when necessary adjust stop-cock 1 so as to maintain the column at mark a or close to it. Then measure the water in the container and divide the number of cc by the number of minutes it flowed. The result shows the number of cc delivered per minute. The method is fairly accurate, the accuracy being limited chiefly by the errors in reading the manometer.

When working with a well aerated soil the water delivered may amount to about 100 cc per minute, while with a closely packed clay soil or a sandy soil from a low spot the result may be but 1/25 of that.

THE WEIGHT OF A SOIL. - This can not be used as a direct measurement of aeration but it is helpful in determining that, for weight depends partly upon how closely the soil is packed. Aside from that it is necessary to know the approximate weight of a soil in order to calculate percentage of water, humus, fertilizers, etc.

Samples for weight determination should be taken from cultivated soil, preferably several months after the land has been prepared for planting. The samples should be taken when the soil is fairly wet and to a depth not exceeding that reached by the plow. Have made tubes of heavy galvanized iron 3-9/16 inches in diameter and 10 inches long. The surface area of the end of such a tube is almost exactly 10 square inches and knowing that, it can be used for other purposes, which will be described in another articles. Have covers with outside flanges made for the tubes, into one of which should be soldered a narrow bore drain pipe about an inch long. When taking a sample the cover carrying the drain pipe is removed, the tube is placed upright and pressed into the soil; if necessary the top cover is pounded with a maul in order to make the tube enter. The tube is then dug out, the bottom cover replaced and it is carried to the house with the least possible shaking.

When making the determination the length of the soil core is carefully measured. Disks of heavy blotting paper are placed over each end of the core and the cover carrying the drain pipe is placed on the lower end after which the tube is set upright with the drain pipe entering a bottle. Water is added slowly from time to time, as it sinks into the soil, until it drips into the bottle. When some has collected in the bottle the soil is left to drain thoroughly after which it is ready for weighing. The tube with the soil is weighed, after which the soil is dug out and the empty tube weighed. The soil is spread out to dry and ^{when} thoroughly air dry is again weighed. The following example shows the calculations:

Tube with soil	2.546 Kg.
Empty tube	<u>0.410 Kg.</u>
Saturated soil	2.136 Kg.
Air dry soil	<u>1.760 Kg.</u>
Water	0.376 Kg.

The area of a tube is 1/14.46 of a square foot; therefore, $1.760 \times 14.46 = 25.449$ Kg. is the weight of a square foot of soil at the depth of the sample taken, - 8 inches in the above example. For calculating the weight of the soil covering an acre 8 in. deep multiply $25.449 \times 43560 = 1,108,558$ Kg. = 2,433,827 lbs. Therefore, in this case less than 7 inches of soil weighs two million pounds per acre. Of some fine grained sandy soils that pack closely 6-1/2 inches or less weigh two million pounds, whereas of a loose clay soil with good crumb structure it will take 8 inches or more to weigh that much.

ONE INCH RAIN. - That is a precipitation which deposits a layer 1 inch deep over the entire soil surface; it means 144 cubic inches on a square foot which will weigh about 2.360 Kg. In the foregoing example the tube was saturated with 0.376 Kg. water. Therefore a square foot of that soil, 8 inches deep, will retain $0.376 \times 14.46 = 5.437$ Kg. or, stating it in another way, the water-holding capacity of that soil in situ is 2-1/3 inches rain.

